

A field guide to the dung beetles (Scarabaeidae:Scarabaeinae and Aphodiinae) common in pastures in South-western Australia

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Abstract

A key to 4 native and 7 introduced species of dung beetles (Scarabaeidae:Scarabaeinae and Aphodiinae) common in pastures in south-western Australia is provided, together with notes on their distribution and biology. Scanning electron micrographs are given to assist in the separation of the species and distribution maps are provided.

Introduction

The species considered here are dung feeding beetles of the family Scarabaeidae (subfamilies Scarabaeinae and Aphodiinae). There are 19 species of Scarabaeinae and 7 species of Aphodiinae which are endemic to the south-western region of Australia, many of which are described by Matthews (1972, 1974), with new records by Ridsdill-Smith *et al* (1983 and unpubl data). The adults of all these endemic species are trapped in undisturbed vegetation (Ridsdill-Smith *et al* 1983), during the cool humid period of the year from May to September (Ridsdill-Smith & Hall 1984a). Four of the endemic Scarabaeinae are also trapped in pastures, but only *Onthophagus ferox* Harold is common (Ridsdill-Smith & Hall 1984b). Six species of cosmopolitan Aphodiinae are present in pastures, of which *Aphodius pseudolividus* Balthasar is most common (Snowball 1942, Ridsdill-Smith & Hall 1984b).

To increase breakdown of cattle dung in pastures throughout Australia, CSIRO has been introducing species of Scarabaeinae from Africa and Europe. Over 500 releases of beetles of 14 species have been made in south-western Australia between 1972 and 1986, of which 9 species are known to be established by 1987. Seven species are common. Since 1978 these introduced species have become dominant members of the dung beetle fauna in pastures in south-western Australia.

Because introduced dung beetles are now abundant in pastures, there is considerable interest in which species are present, their biology and seasonal abundance. In this field guide we summarize data we have collected over the past 10 years on the biology and distribution of species common in pastures. We have omitted both introduced and endemic species which are not commonly encountered. The distribution of some of these species may change in the future, and further introduced species may become abundant. A key is provided to separate the 4 native and 7 introduced species which are common in pastures in south-western Australia. Only adults are described and data on occurrence and abundance refer to the adult stage.

Identification of species

Description of characters

Males and females of all species except *A. pseudolividus* can be distinguished by examining the ventral abdominal segments (Figs 1B and C). In the males the segment before the pygidium is constricted in the mid-line, whereas in the female it is of even width. Horn size in horned beetles varies and some specimens may be worn or damaged, and thus a combination of characters should be used for identification.

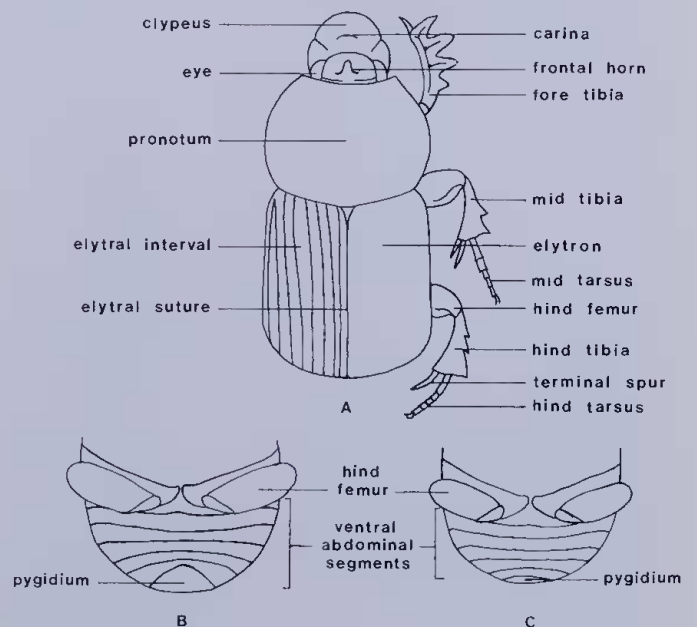


Figure 1 A Stylized dung beetle showing parts referred to in key. Underneath of abdomen showing method of sexing scarabaeine B males and C females.

Glossary

bidentate—with 2 teeth, or teeth-like processes (eg-clypeal margin in Fig 6H)
 bifid—forked, opening with a medial cleft (eg-horn in Fig 6D)
 carina—keel-like ridge (Fig 1A)
 clypeus—the antero-median part of the head (Fig 1A)
 elytral interval—space between lines (striae) on elytra (Fig 1A)
 lamina—a plate-like projection (eg-Figs 6E,F)
 pubescent—covered with hair (eg-Fig 6C)
 pygidium—the terminal abdominal segment (Fig 1B)
 rugose—with wrinkles and ridges (eg-clypeus in Fig 3E)

Key to species

1 Pronotum green, brown or coppery; elytra brown -2
 Pronotum black or with a bronze sheen; elytra black -7
 2(1) Small, shining beetles, total length <5mm; pronotum blackish-brown medially with pale margins; elytra totally covering the pygidium; hind tibia with two terminal spurs (Figs 2A,C)-*Aphodius pseudolividus* Balthasar
 Larger, less shining beetles, total length >7mm; pronotum variously coloured; elytra not covering the pygidium (Fig 2B); hind tibia with one terminal spur -3
 3(2) Total length >12mm; fore tarsi absent; dorsal part of eyes wide (Figs 3E,F); males with 1 or 2 spines on the hind femora (Figs 3G,H) and fore tibiae elongate (Fig 3A); females with a carina on the clypeus (Figs 3E,F) -4
 Total length <12mm; fore tarsi present; dorsal part of eyes narrow (Figs 2D-H); males without spines on hind femora, fore tibiae not elongate (Fig 3B); females without a carina on the clypeus (Figs 2F,H,3D) -5
 4(3) Male with 1 outwardly facing spine on the posterior edge of the hind femora (Fig 3G); female with a squarish clypeus which has a carina equidistant between the eyes and the anterior edge (Fig 3E) -*Onitis alexis* Klug
 Male with 2 inwardly facing spines on the posterior edge of the hind femora (Fig 3H); female with a rounded clypeus which has a carina nearer to the anterior edge than to the eyes (Fig 3F) -*Onitis aygulus* Fabricius
 5(3) Fringe of long hairs on apex of elytra restricted to area near suture; head of male with two carinae (Fig 2G); head of female lacking carinae (Fig 2H); pronotum lacking distinct "speckled" markings
 -*Euoniticellus fulvus* (Goeze)
 Fringe of long hairs on apex of elytra extending along whole apical edge; head of male either with a single horn (Fig 3C) or with 3 carinae (2 in some small males) (Figs 2D,E); head of female with a carina level with front of eyes and another carina at the back of the head (Fig 3D); pronotum with distinct "speckled" markings -6
 6(5) Head of male with a single horn (Fig 3C); head of female with clypeus smooth and frontal carina of even height (Fig 3D); pronotal "speckling" appearing light-brown
 -*Euoniticellus intermedius* (Reiche)
 Head of male with 3 carinae (2 in some small males) (Figs 2D,E); head of female with clypeus rugose or heavily punctured, not smooth and frontal carina raised in the centre (Fig 2F); pronotal "speckling" dark-brown to black
 -*Euoniticellus pallipes* (Fabricius)

7(1) Male and female with similar head and pronotal armament; head with single horn, entire at apex; pronotum with two forward-projecting horns. Total length >10mm (Figs 5A-D)
 -*Onthophagus ferox* Harold
 Head and pronotal armament different to above; male head with either single horn bifid at apex, a lamina, two horns at the back of the head, or no horns; pronotum with projections or not. Total length <10mm -8
 8(7) Elytral intervals with a median row of prominent, shiny, raised lines or beads (Figs 6B,E) -9
 Elytral intervals flat, without sculpturing (Figs 4A,E) -10
 9(8) Dorsal surface bronzed; pronotum without prominent projections, pubescent; head with some scattered hairs and clypeal margin feebly bidentate (Fig 6G); total length <8mm (Figs 6A,B,C)
 -*Onthophagus vermiculatus* Frey
 Entirely black; pronotum with projections in both sexes, not pubescent; head with hairs only along front margin and clypeal margin medially more strongly bidentate (Fig 6H); male with either high bifid horn or two-pointed lamina on head; total length >8mm (Figs 6D,E,F)
 -*Onthophagus haagi* Harold
 10(8) Pronotum without lobes in both sexes; head of male either with a pair of curved horns arising between the eyes and extending back along sides of pronotum or with horns much reduced or replaced by a carina; head of female with a carina between the eyes (Figs 4A,B,C)
 -*Onthophagus taurus* (Schreber)
 Front of pronotum with a prominent median lobe, subquadrate or rounded; head of both male and female without horns, with a carina between the eyes (Figs 4D-H)
 -*Onthophagus binodis* Thunberg

Notes on the species

Locations mentioned in the text are shown in Fig 8F.
 a) *Aphodius pseudolividus* Balthasar. (Figs 2A,C)
 A small shining beetle (4.5 mm long) which is elongate and brown. This accidentally-introduced species occurs widely in Australia and in other countries (P Hammond, pers comm).
 There are two patterns of seasonal abundance in south-western Australia. At sites north of Perth, beetles are common in all seasons and fly during the day. At sites south of Perth they are most common in summer and autumn (December to May) and fly at dusk. Some individuals are found throughout the year at all sites.
 Distribution: (Fig 7A) Widespread throughout the region, where it is common in pastures, but rare in undisturbed vegetation.
 b) *Euoniticellus fulvus* (Goeze). (Figs 2B,G,H)
 Brownish-yellow beetle (7-11mm long) with a plain brown pronotum. An introduced beetle from Europe. The strain released is from France.
 This species is abundant in summer and autumn. It breeds during summer and flies during the day.
 Distribution: (Fig 7B) Current records are from Bridgetown and near Bunbury.

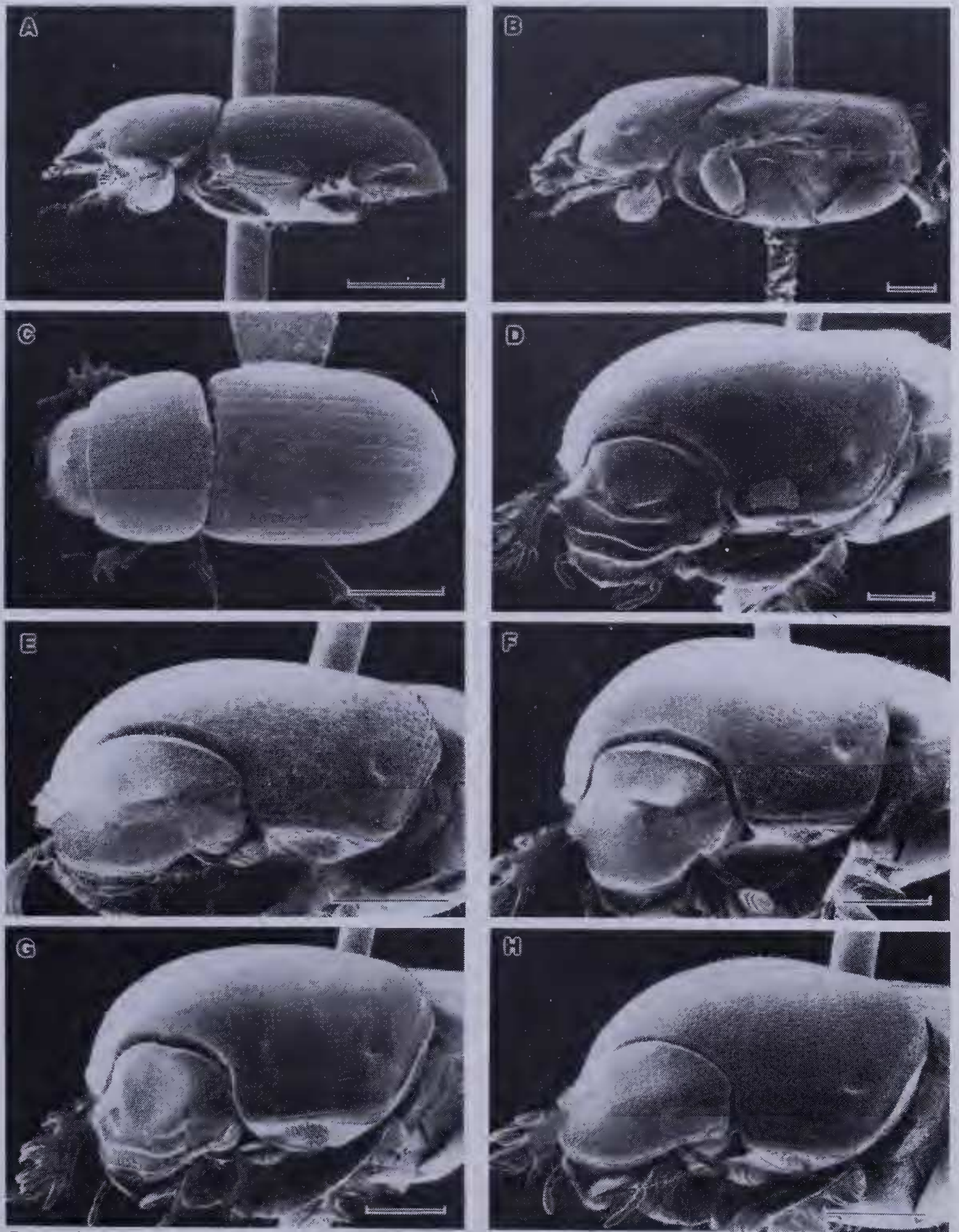


Figure 2 Dung beetles. Elytra covers pygidium in **A**. *A. pseudolivoidus*, but not in **B** *E. fulvus*. **C** *A. pseudolivoidus*; **D** & **E** *E. pallipes* males; **F** *E. pallipes* female; **G** *E. fulvus* male; **H** *E. fulvus* female. Scale lines: 1 mm.

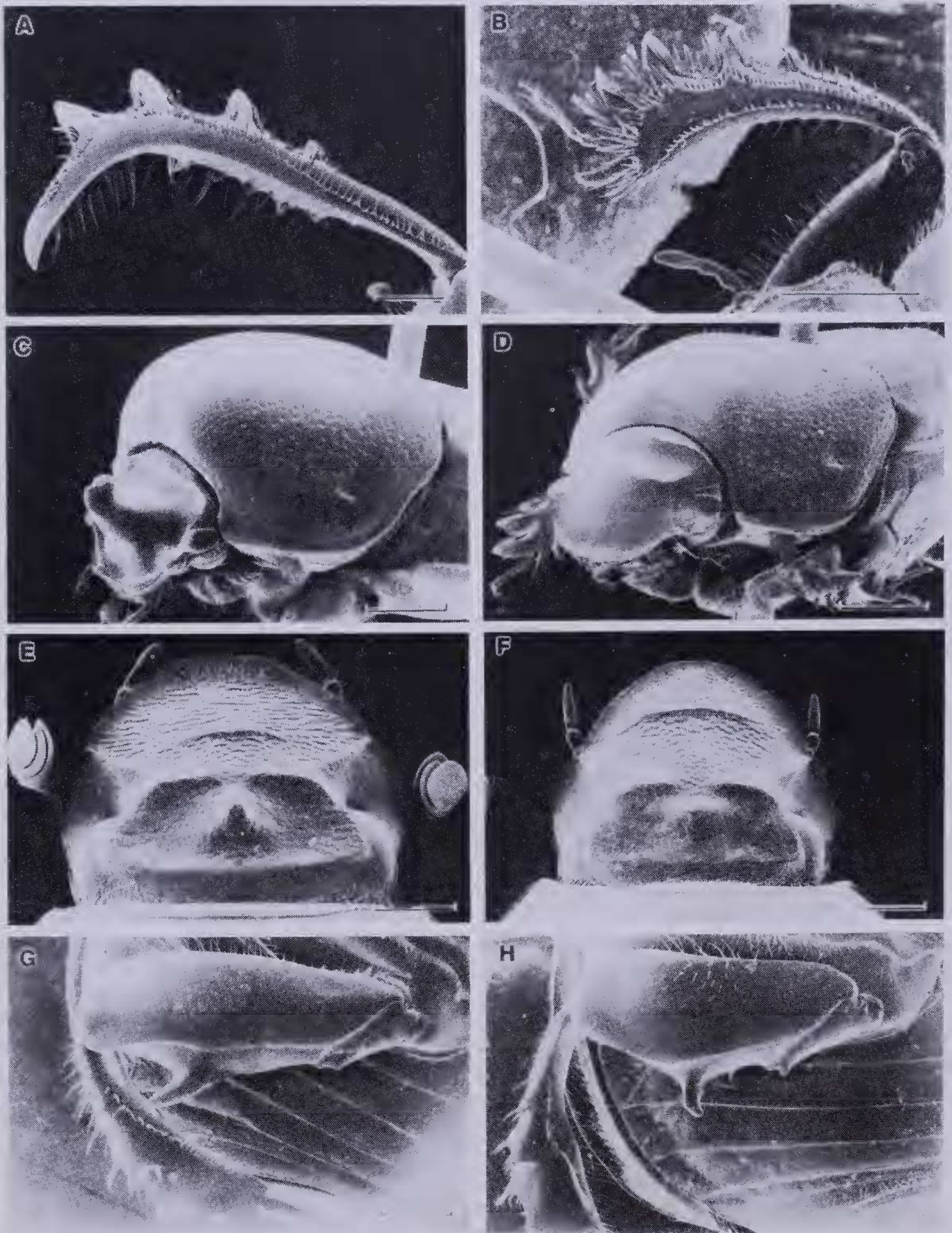


Figure 3 Dung beetles. Foreleg of **A** *Onitis* sp. and **B** *Euoniticellus* sp.; **C** *E. intermedius* male; **D** *E. intermedius* female; **E** Head of *O. alexis* female; **F** Head of *O. aygulus* female; **G** Hind femur of *O. alexis* male; **H** Hind femur of *O. aygulus* male. Scale lines:1 mm.

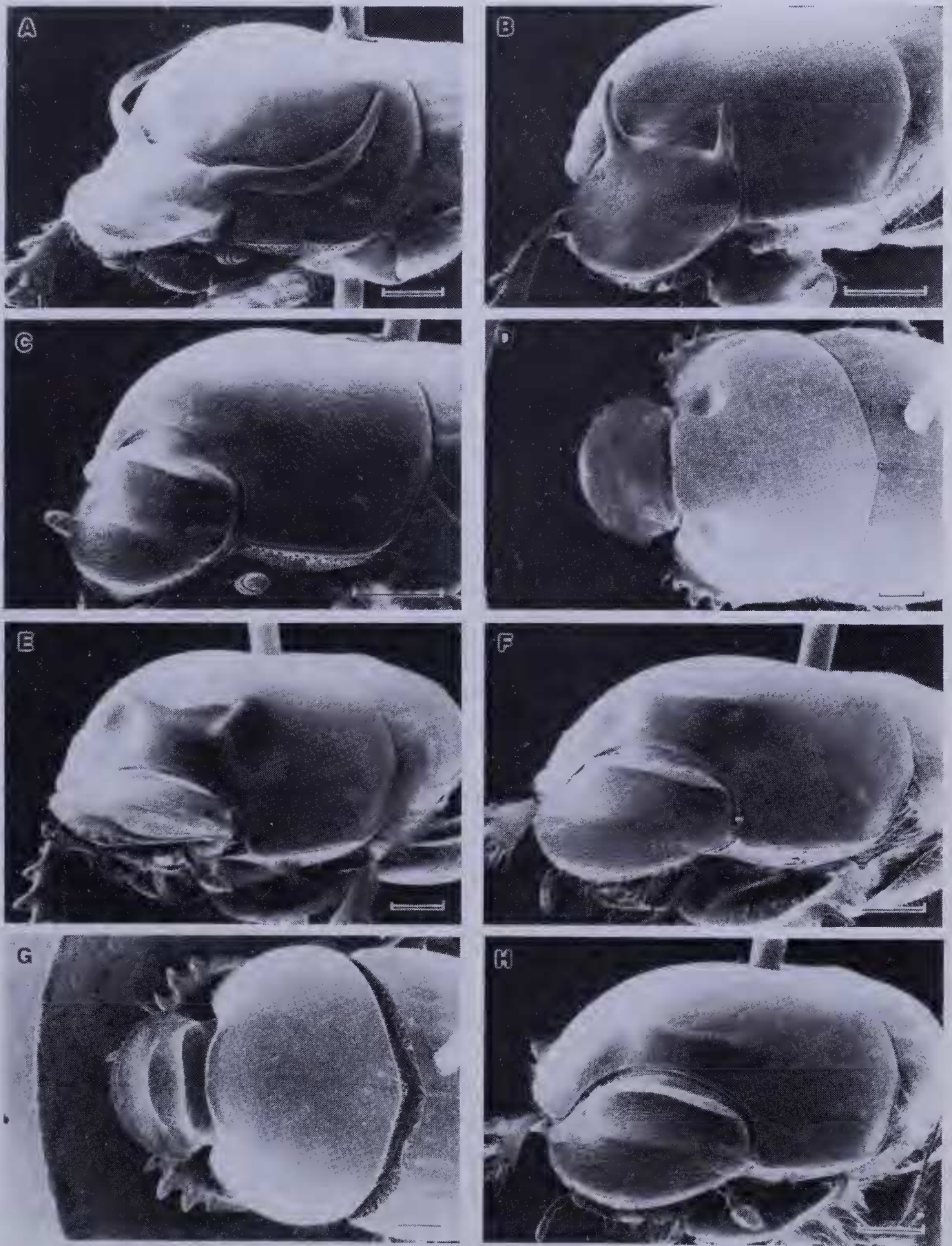


Figure 4 Dung beetles. **A & B** *O. taurus* males; **C** *O. taurus* female; **D, E & F** *O. binodis* males; **G & H** *O. binodis* females. Scale lines: 1 mm.

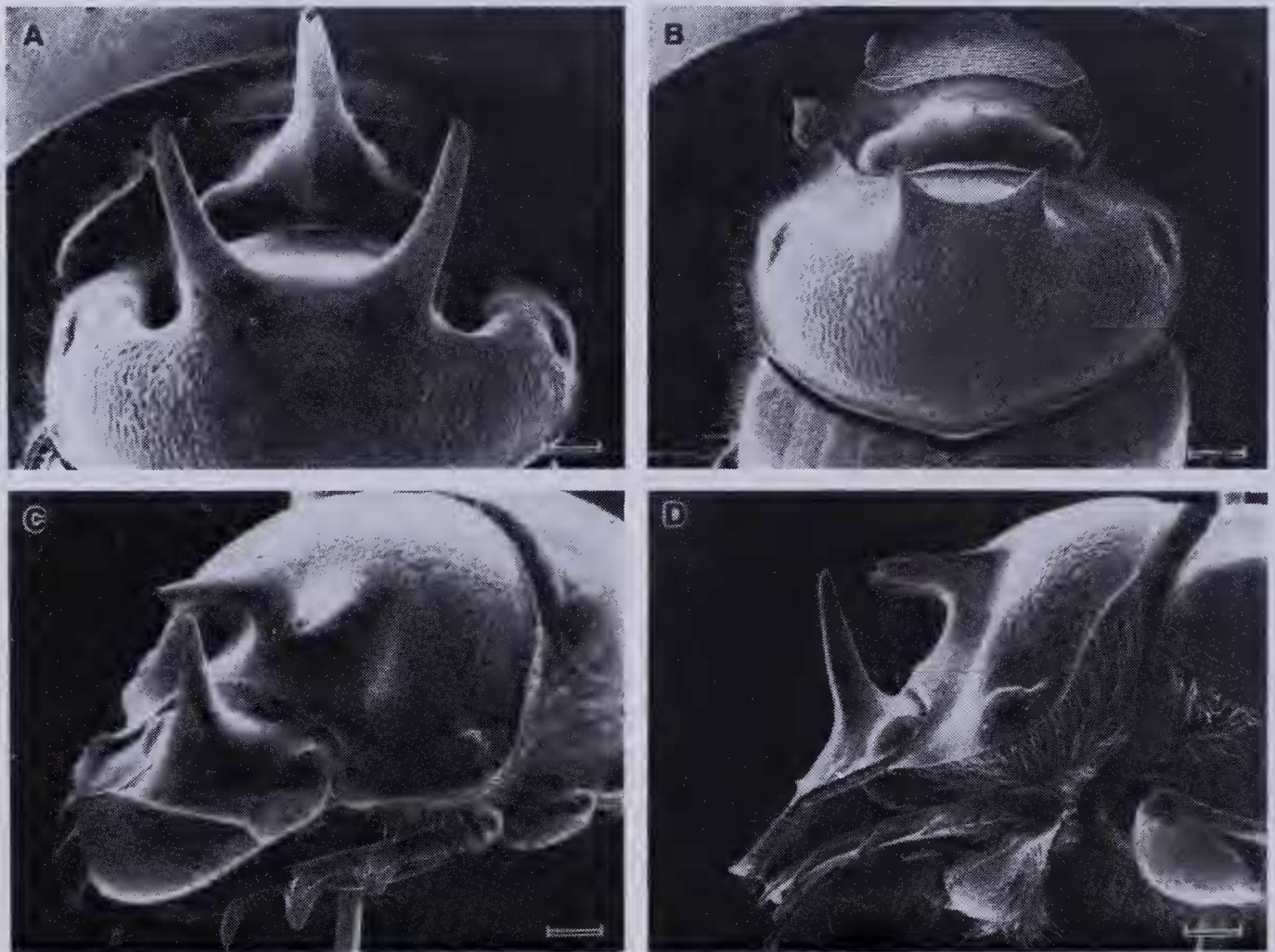


Figure 5 Dung beetles. **A & B** *O. ferox* males; **C & D** *O. ferox* females. Scale lines:1 mm.

c) *Euoniticellus intermedius* (Reiche). (Figs 3C,D)

A brownish-yellow speckled beetle (7-10mm long) with a small horn on the head of the male. An introduced species from southern Africa. One of the first species to be released in the region in 1972.

Adults are present all year round with peaks of abundance in winter and in summer, and breeds mainly at these times. Beetles fly during the day. *E. intermedius* is common in pastures near Moora, adjacent to sites of dung beetle studies in undisturbed vegetation (Ridsdill-Smith & Hall 1984a). Out of 19109 scarabaeine and aphodiine dung beetles trapped during 1982-1984 only 8 are *E. intermedius*. There is no evidence that they are competing with endemic beetles.

Distribution:(Fig 7C) Mainly in the hotter parts of the region from Geraldton to Perth and eastward to Bruce Rock. This species is adapted to dry conditions. Adults can breed in very dry, sandy soil (Barkhouse & Ridsdill-Smith 1986).

d) *Euoniticellus pallipes* (Fabricius). (Figs 2D,E,F)

A brownish-yellow beetle (6-11mm long) with dark-brown to black speckling. An introduced species native to Europe and Asia. The strains released are from Iran and Turkey.

Adults are most abundant in summer and autumn, and breed mainly from January to March. Low numbers are also seen in spring. Beetles fly during the day.

Distribution: (Fig 7D) Southern half of the region, from Perth to Bruce Rock, but not present along the south coast.

e) *Onitis alexis* Klug. (Figs 3E,G)

A robust large beetle (12-19mm long) with greenish pronotum and brown elytra. An introduced species from southern Africa. The strain released is the cold-adapted strain from summer rainfall regions.

This species emerges in November and is abundant for a month; the second generation emerges in March. The species spends the winter as larvae in brood masses in the soil. Beetles fly at dusk.

Distribution:(Fig 7E) Mainly in the warmer drier parts of the region from Geraldton to Pinjarra, and Perth to Cunderdin.

f) *Onitis aygulus* Fabricius. (Figs 3F,H)

The largest of the dung beetles present in pastures (18-23mm long). A coloured beetle with greenish pronotum and brown elytra. An introduced species from southern Africa. The strain released is a winter-rainfall strain.

The biology of this species is very similar to that of *Onitis alexis*. Beetles fly at dusk.

Distribution:(Fig 7F) Mainly in drier areas between Cunderdin and Williams, and from Pinjarra to Hyden. The distribution of this species tends to be more southerly than that of *Onitis alexis*.

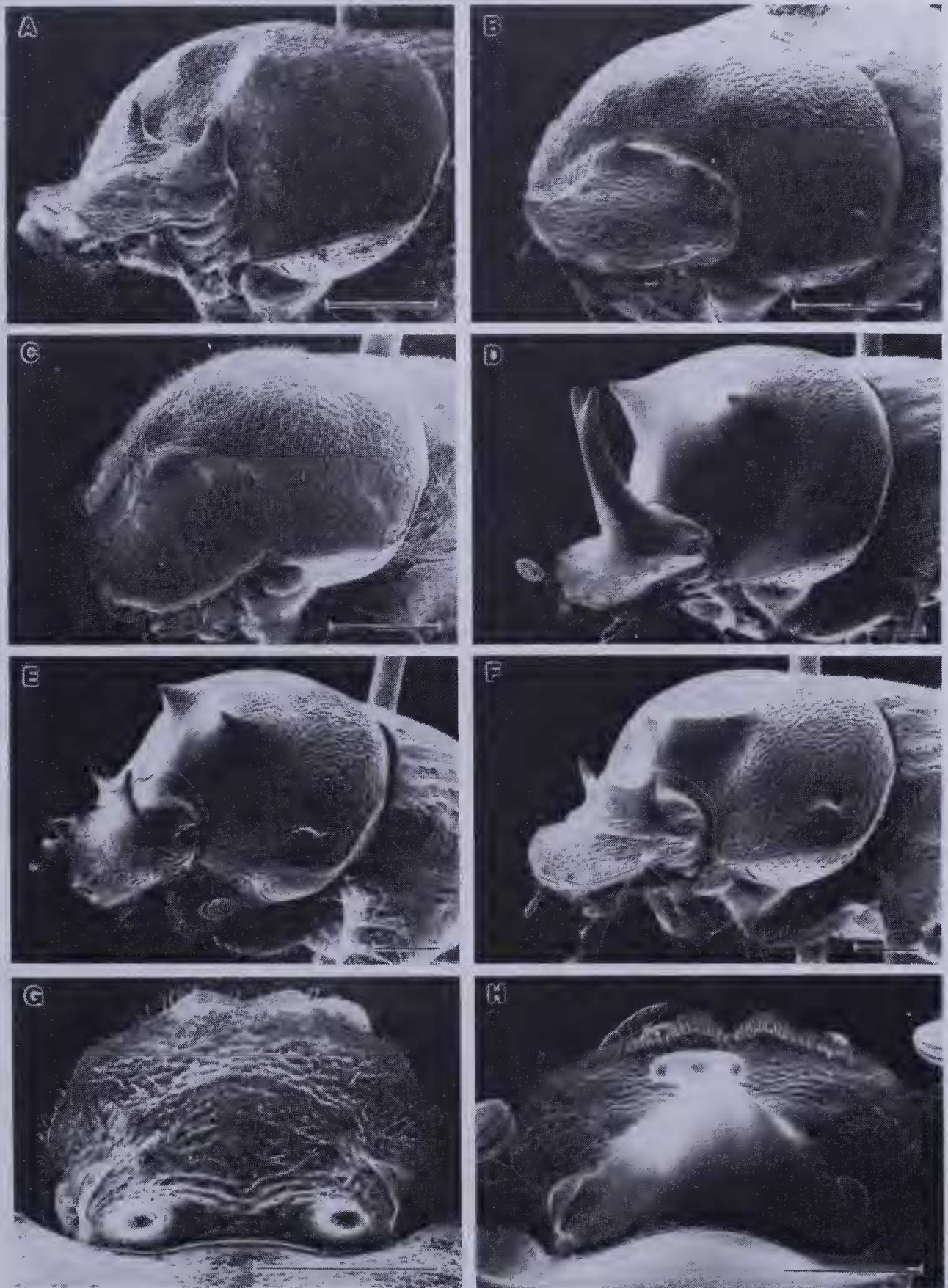


Figure 6 Dung beetles. **A & B** *O. vermiculatus* males; **C** *O. vermiculatus* female; **D & E** *O. haagi* males; **F** *O. haagi* female; **G** Head of *O. vermiculatus* male; **H** Head of *O. haagi* male. Scale lines: 1 mm.

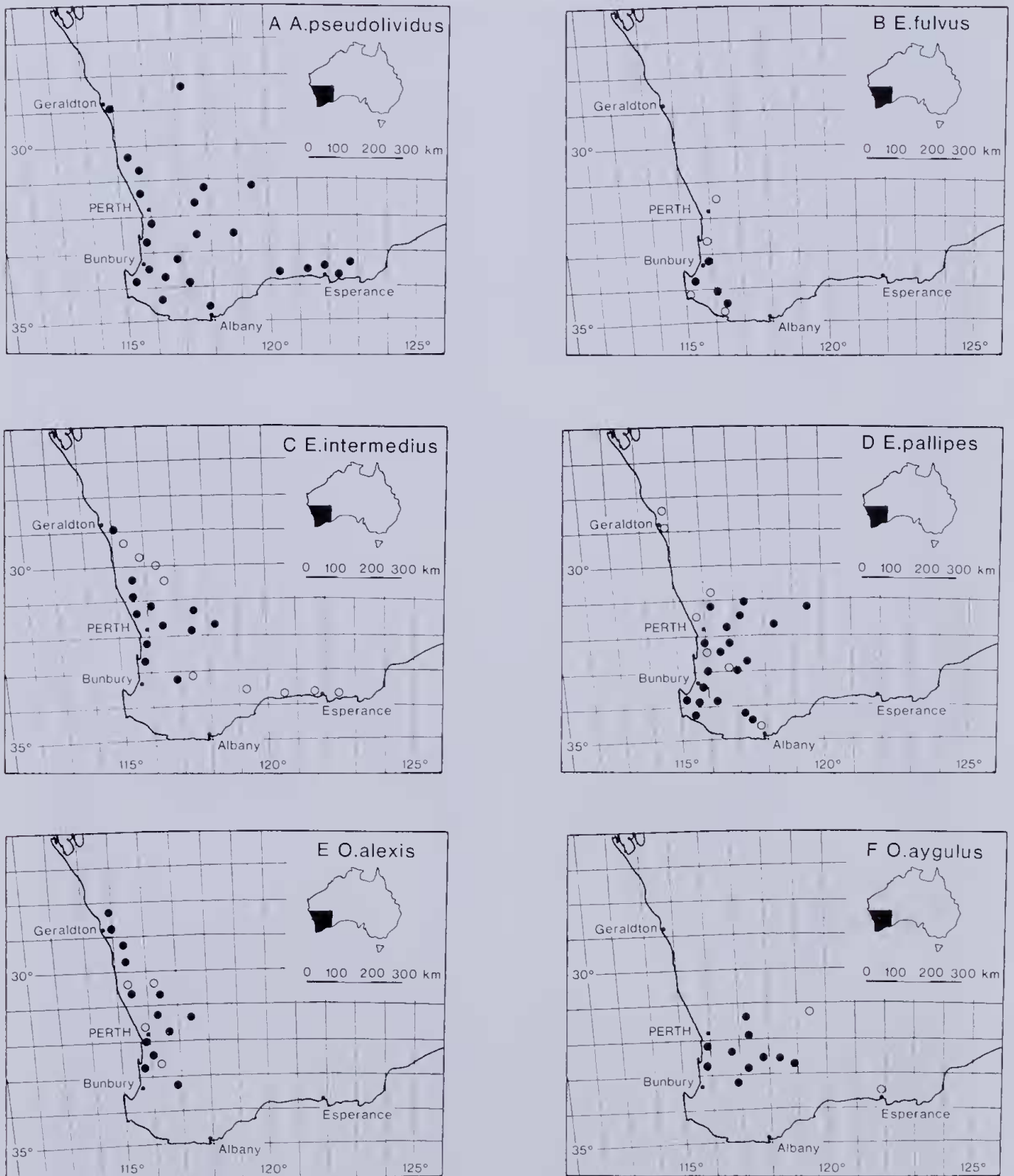


Figure 7 A - F Distribution maps for *Aphodius*, *Euoniticellus* and *Onitis* spp. Full circles represent establishment and open circles represent releases where the species has not yet been recovered.

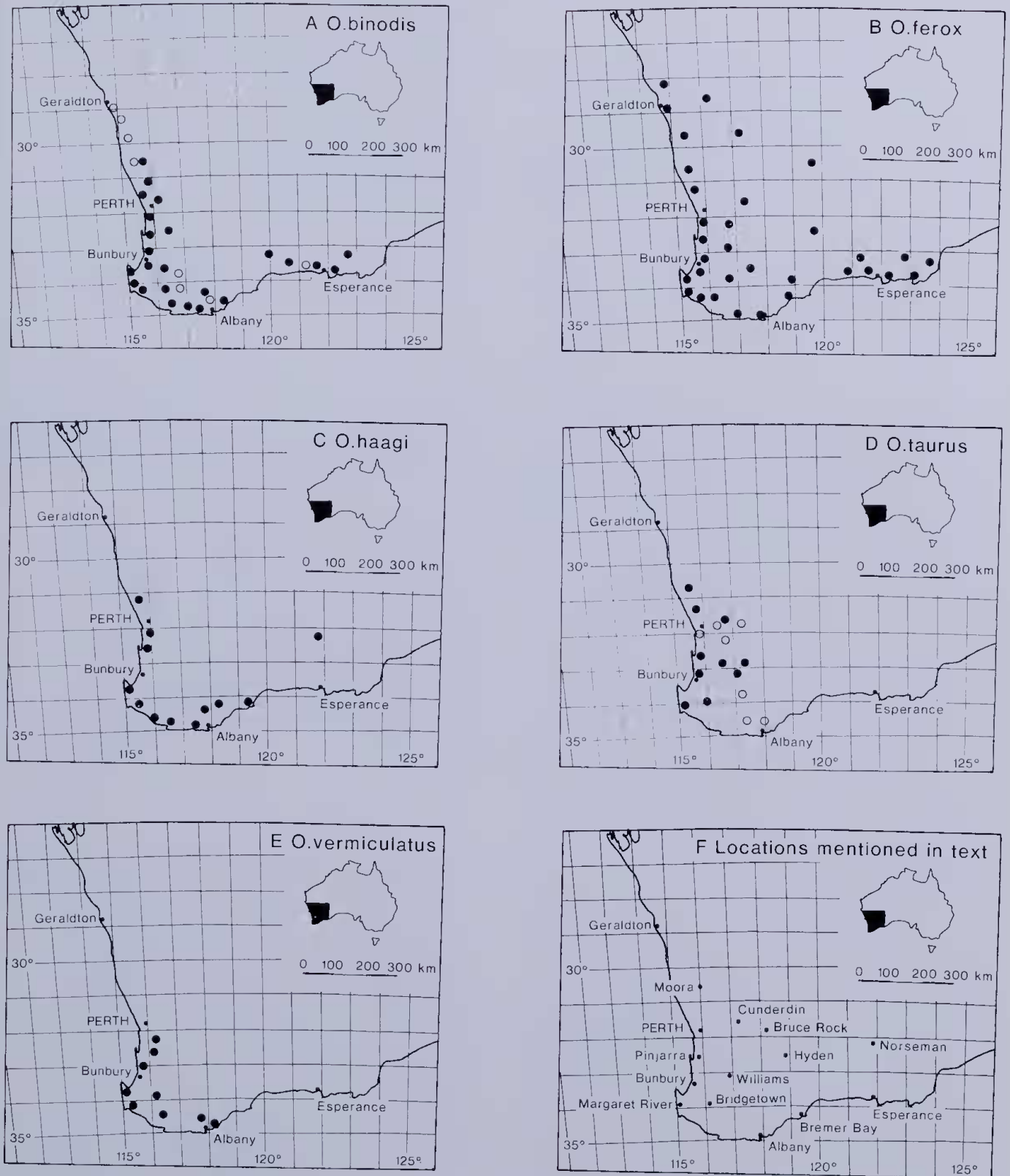


Figure 8 A - E Distribution maps for *Onthophagus* spp. Full circles represent establishment and open circles represent releases where the species has not yet been recovered. **F** Locations mentioned in text.

g) *Onthophagus binodis* Thunberg. (Figs 4D-H)

A matt black beetle (7-12mm long) with a lobe on the pronotum. An introduced beetle from southern Africa. Nearly all releases are of the winter rainfall strain.

This species is very abundant in summer and autumn, and in lower numbers in winter. Mainly breed in spring but some breeding also occurs during the summer. Flies during the day. Out of 19109 scarabaeine and aphodiine dung beetles trapped in undisturbed vegetation over two years at six sites (Ridsdill-Smith & Hall 1984a) there are 12 *O. binodis*. There is no evidence that they are competing with endemic beetles.

Distribution:(Fig 8A) Mainly in the higher rainfall areas along the coast from Moora to Esperance. Does not persist in drier areas. More abundant at sites with some summer moisture or irrigation. Adults cannot not breed in dry, sandy soil (Barkhouse & Ridsdill-Smith 1986).

h) *Onthophagus ferox* Harold. (Fig 5)

A large robust shining black beetle (12-20mm long) with one horn on its head and two on the pronotum. This is a native species.

Adults are active during the cool humid period of the year (Ridsdill-Smith & Hall 1984a,b). To the north of Perth this is from May to September and to the south from May to December. It is most abundant in May and June and breeds in the spring. Adults fly at night and are commonly found at lights. It is rarely seen during the summer, although a few individuals are found at this time along the south coast, and some emerge after summer thunderstorms at Cunderdin.

Distribution:(Fig 8B) Widespread throughout the south-west region. There are two unconfirmed records from Alice Springs. It is also found in undisturbed vegetation, where it is more common at jarrah forest and heath sites than in karri forest (Ridsdill-Smith *et al* 1983).

i) *Onthophagus haagi* Harold. (Figs 6D,E,F,H)

A black, shining beetle (8-10mm long) with a single horn or a lamina with two points on the head. This is a native species.

Adults are active during the cool humid period from May to September. It is most abundant in May, June, August and September and breeds in the spring. Adults fly during the day. Adults are rarely found during the summer, except along the south coast.

Distribution: (Fig 8C) Mainly in the higher rainfall areas along the coast from Perth to Bremer Bay. There is one unconfirmed record from Norseman. It is present also in undisturbed vegetation, where it occurs in jarrah forest and heath. It appears to be more common near swamps.

j) *Onthophagus taurus* (Schreber). (Figs 4A,B,C)

A shining black beetle (7-10mm long) with two long curving horns on the head of the male. This is an introduced species, and the strains released are from Greece, Spain, Italy and Turkey.

It is most abundant in the summer and breeds in the spring. Adults fly during the day. Beetles are more abundant at sites with summer moisture or irrigation and breeding continues at these sites during the summer.

Distribution: (Fig 8D) Moora to Margaret River, and from Pinjarra to Williams.

k) *Onthophagus vermiculatus* Frey. (Figs 6A,B,C,G)

A small black beetle (5-8mm long) with bronze reflections. This is a native species.

Adults are present mainly during the cool humid period from March till November.

Distribution:(Fig 8E) Perth to Albany in undisturbed vegetation including karri forest, jarrah forest and heath. It appears in pastures near the south coast at Albany.

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